International Comparison of Smoking and Metabolic Control in Patients With Type 1 Diabetes

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Smoking may influence metabolic control and increase the risk of vascular complications in type 1 diabetes (T1D) (1,2). Antismoking public health policy may influence smoking habits in the population with diabetes; therefore, different behaviors between Europe and the U.S. may be expected (3,4). The T1D Exchange Registry (T1DX) in the U.S. and the Prospective Diabetes Follow-up Registry (DPV) in Germany and Austria are two large consortia of diabetes centers, which used their data sets to describe the prevalence of smoking habits in adults with T1D and analyzed the relationship between smoking status and metabolic outcomes.

Our analyses include 20,405 patients with T1D aged ≥18 years and with T1D duration ≥1 year (10,579 participants from 65 T1DX centers and 9,826 participants from 297 DPV centers). Smoking status was defined by smoking at least one cigarette per day, former smokers reported smoking in the past, and nonsmokers never smoked. Smoking data were self-reported in both registries.

Wilcoxon or χ-square tests were used for unadjusted comparisons between registries and between smoking groups. Smoking rates adjusted for age-group and sex were compared between registries using multinomial logistic regression models. Hierarchical linear regression models were run to examine associations between smoking status and clinical outcomes within each registry.

Patients from both registries were similar with respect to age and HbA$_{1c}$. The proportion of smokers in T1DX and DPV was 10.0% vs. 24.3% ($P < 0.001$); of former smokers, 18.1% vs. 5.1% ($P < 0.001$); and of nonsmokers, 72.0% vs. 70.6% ($P < 0.001$). The number of smokers was significantly higher across all ages in DPV (Fig. 1), smokers were more likely male than female (T1DX 12.0% vs. 9.0%, $P < 0.001$; DPV 27.7% vs. 20.3%, $P < 0.001$), and the majority of smokers were under the age of 50 years (80.0% in T1DX and 77.9% in DPV). Smokers had significantly higher HbA$_{1c}$ levels (8.5% vs. 7.9% [70 vs. 62 mmol/mol], $P < 0.001$) after adjustment for age-group, sex, T1D duration, and migration background/not non-
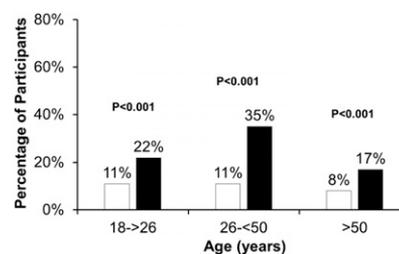

Figure 1—Proportion of self-reported current smokers in three age groups (18 to <26, 26 to <50, and ≥50 years) in both registries T1DX (white bars) and DPV (black bars). Data are adjusted for sex.

Hispanic white. Smokers showed an unfavorable lipid profile with significantly higher triglycerides (1.62 vs. 1.35 mmol/L, $P < 0.0001$) after adjustment for age, sex, diabetes duration, BMI, and lipid-lowering medication and had higher LDL levels (2.78 vs. 2.67 mmol/L, adjusted $P < 0.0001$).

Treatment strategies in T1D focus on glycemic control as the main treatment goal. Our data clearly show higher HbA$_{1c}$ and additional unfavorable lipid profiles in patients with T1D who smoke. The proportion of smokers was significantly

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higher in DPV, peaking at 35% in 26- to 50-year-olds. We observed a significantly higher number of former smokers in the U.S., implying that interventions to reduce tobacco consumption and smoke-free policies have been more successful in the U.S. compared with Europe. The high proportion of smokers in DPV and the low number of former smokers (6%) clearly show that further activities toward tobacco cessation are needed in Europe. Possible limitations are differences in data collection methods between registries (population based in DPV and center based in T1DX) and assessment of smoking status by self-report (5).

References

1. Chase HP, Garg SK, Marshall G, et al. Cigarette smoking increases the risk of albuminuria among subjects with type I diabetes. JAMA 1991;265:614–617
2. Pan A, Wang Y, Talaei M, Hu FB. Relation of smoking with total mortality and cardiovascular events among patients with diabetes mellitus: a meta-analysis and systematic review. Circulation 2015;132:1795–1804
3. Centers for Disease Control and Prevention. *Best Practices for Comprehensive Tobacco Control Programs—2014*. Atlanta, National Center for Chronic Disease Prevention and Health Promotion, Office of Smoking and Health, 2014
4. Duina F, Kurzer P. Smoke in your eyes: the struggle over tobacco control in the European Union. J Eur Public Policy 2004;11:57–77
5. Connor Gorber S, Schofield-Hurwitz S, Hardt J, Levasseur G, Tremblay M. The accuracy of self-reported smoking: a systematic review of the relationship between self-reported and cotinine-assessed smoking status. Nicotine Tob Res 2009;11:12–24